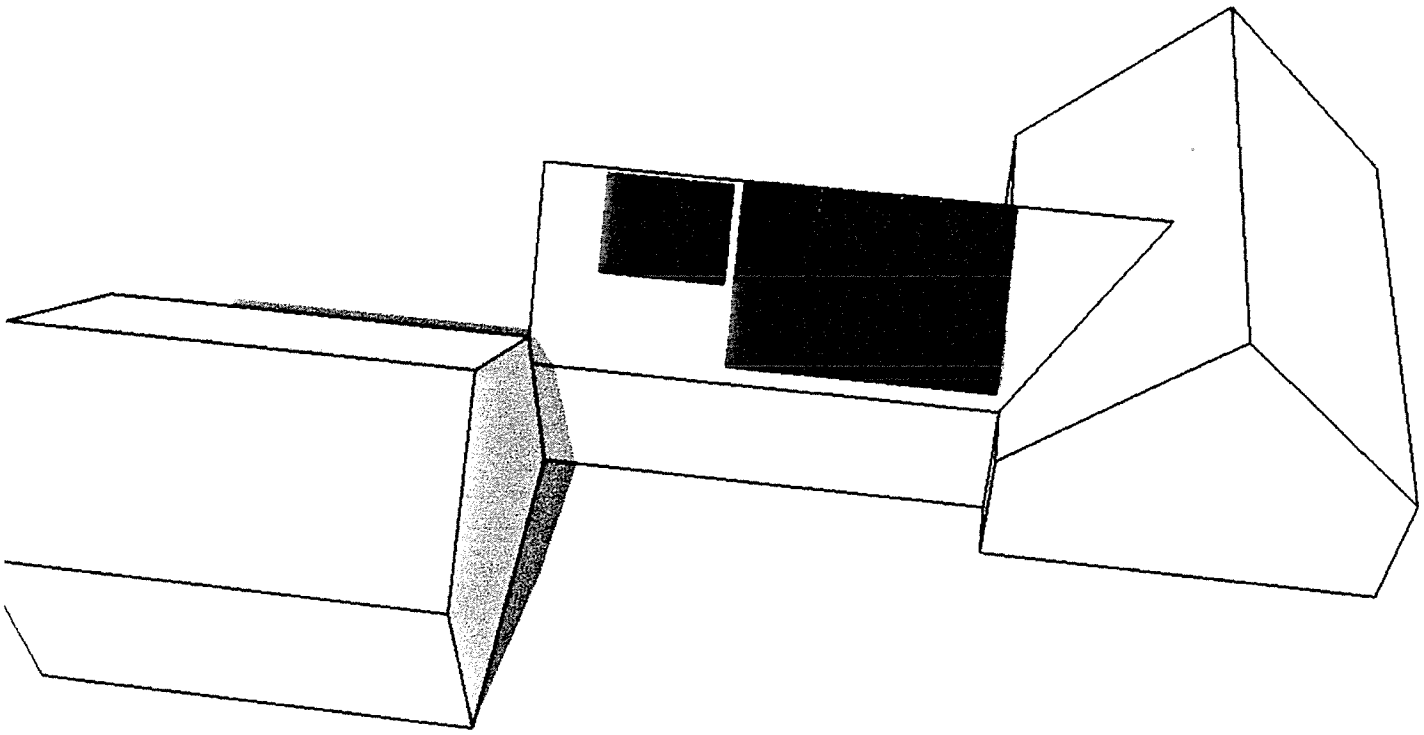
Doug Gerry



Water heating system seasonal efficiency

The user enters the average efficiency (%) of the conventional water heating system over the season of use. This value is used to calculate the financial value of the system. It has no influence on the calculation of the annual renewable energy production. Typical values range from 50 % for conventional fossil-fuel-fired water heaters to nearly 100 % for electric heaters. If a heat-pump is used as a base case (e.g. for swimming pool applications) the user will select "Electricity" as the heating fuel type and may enter values higher than 100 % to reflect the heat pump coefficient of performance (COP) (e.g. enter 225 % if seasonal COP is 2.25).

Typical values of residential heating system efficiencies are tabulated below. The efficiencies of commercial and industrial water heating systems can vary significantly depending on size, age, technology, condition, installation specifics, etc. and these are not specifically included here. However, the user may use the efficiencies of residential water heating systems as a reference for similar larger systems.

Fuel	Residential Water Heating System Type	Typical Seasonal Efficiency*
Nat'l Gas or Propane	Storage tank (conventional)	50%
	Storage tank (high-efficiency)	70%
	Instantaneous	80%
	Integrated with space heating (tankless coil)	48%
	Induced draft / direct vent (conventional)	55%
	Induced draft / direct vent (high-efficiency)	70%
	Condensing	86%
Oil	Storage tank (conventional)	50%
	Storage tank (high-efficiency)	60%
	Integrated with space heating (tankless coil)	40%
Electricity	Storage tank (conventional)	88%
	Storage tank (high-efficiency)	94%
	Instantaneous	94%
	Heat pump	190%

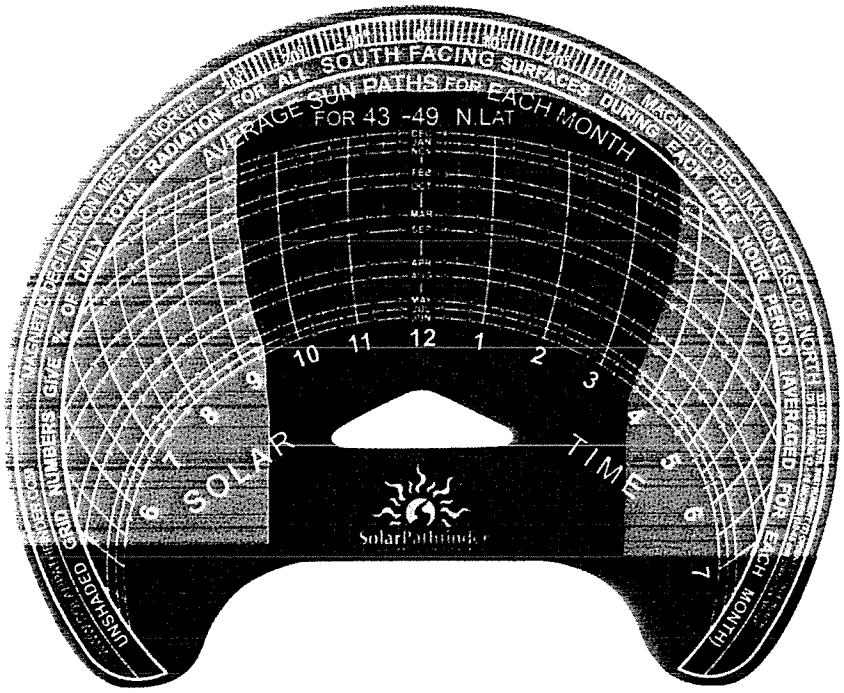
Typical Water Heating System Seasonal Efficiencies

*Note: The efficiency of residential water heating systems is commonly expressed in terms of the Energy Factor (EF). For the purposes of the model it is assumed that the two measures are essentially the same (except that EF is expressed as a decimal). The values in the above table are in fact EF values that were converted to percentages. Seasonal Efficiency is used here because it is a more generic term and more applicable to commercial and industrial water heating systems for which EF ratings don't exist. All shown efficiency values are approximate and typical values.

Solar Site Analysis Report

Report Title	NHPUC	**Array Type**	Fixed
Image File	pathfinder3.jpg	**Tilt Angle**	43.23 degree
Report Date	Sunday, August 29, 2010	**Cost of Electricity**	6 cents/kWhr
Declination	-15d 5m	**DC Rate**	4.00 kW
Latitude/Longitude	43.23 / -71.536	**Derate Factor**	0.77
Analysis Site	CONCORD, NH, Zipcode: 03301	**Azimuth (180 = south)**	180.00 degre
Weather Station	CONCORD, NH, Elevation: 105 m		
Station/Site Distance	2.78 miles		

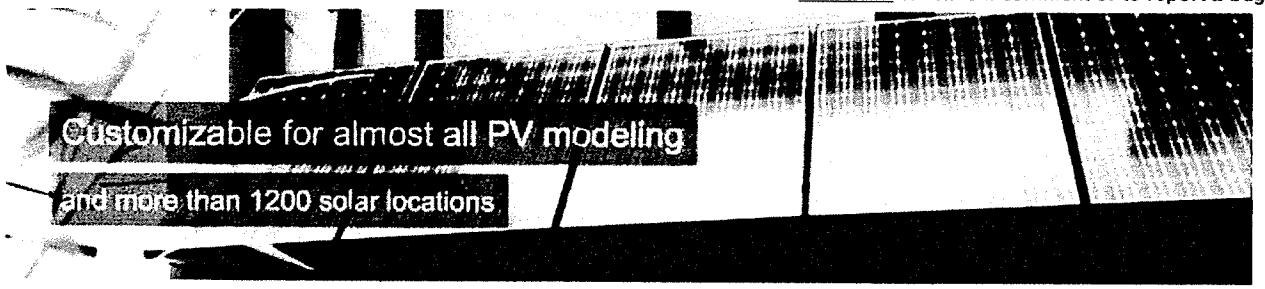
Month	**Unshaded % of Ideal Site Azimuth=180.0 Tilt=43.2**	**Actual Solar Rad w/ Shading Azimuth=180.0 Tilt=43.2 KWH/m^2 /day**
January	86.10%	3.23
February	80.40%	3.71
March	76.40%	3.74
April	76.10%	3.74
May	72.40%	3.75
June	72.90%	3.74
July	72.40%	3.95
August	74.10%	3.94
September	76.40%	3.67
October	80.40%	3.03
November	86.30%	2.55
December	87.10%	2.41
Totals	**78.42%**	--
	Unweighted Yearly Avg	**Effect: 75.02% Sun Hrs: 3.46**



Report generated by SolarPathfinder Assistant Version 1.1.6.0. http://www.solarpathfinder.com

Home

Click here to leave a comment or to report a bug



ReCalculate

PV System

Array Type :	Fixed Tilt
DC Rating(kW):	5
Derate Factor:	77%
Tilt:	43
Direction:	180

PV System Cost

Cost:	Per Watt
Cost Per Watt:	$6.00
Fed Tax Rate:	35 %
Financing:	Home Loan
Loan Rate	7 %
Percent Down:	20
Loan Life:	5 years %

Electric Cost

Increase Rate:	5 %
Usage Pattern:	Standard
Annual Electric:	Cost
Annual Cost:	$2,000

ReCalculate

Data Location: CONCORD MUNICIPAL ARPT , NH (Change) Print\Save PDF

Summary | Rebates | Energy Savings | PV Watt Data | Environmental | Amortization |

Main Details

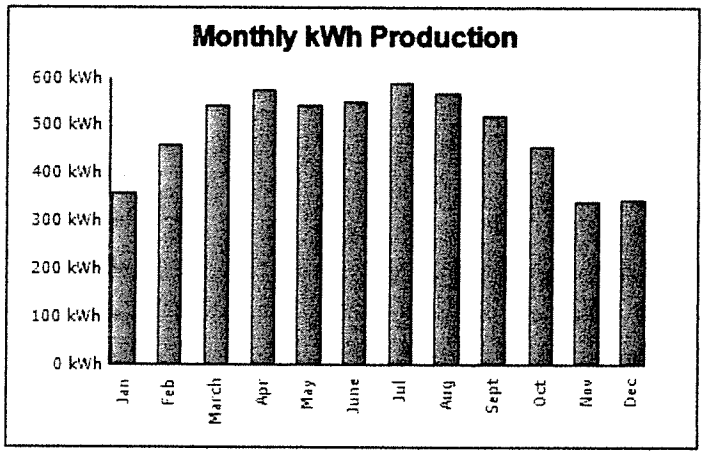
Annual kWh Production:	5,857 kWh
Payback Time:	12 years 2 months
Energy Produced %:	37.50%
Savings over 30 years:	$26,337
PV Module Space:	695ft²

System Cost

PV System Cost:	$30,000
Price Per Watt	$6.00
Rebates and Incentives:	$9,000
Effective System Cost:	**$21,000**

Environmental

CO2 Reduced Annually:	7,839 pounds



PVWatts *** AC Energy & Cost Savings

Cautions for Interpreting the Results

(Type comments here to appear on printout; maximum 1 row of 80 characters.)

Station Identification	
City:	Concord
State:	New_Hampshire
Latitude:	43.20° N
Longitude:	71.50° W
Elevation:	105 m
PV System Specifications	
DC Rating:	5.0 kW
DC to AC Derate Factor:	0.770
AC Rating:	3.8 kW
Array Type:	Fixed Tilt
Array Tilt:	43.2°
Array Azimuth:	180.0°
Energy Specifications	
Cost of Electricity:	12.5 ¢/kWh

Results			
Month	Solar Radiation ($kWh/m^2/day$)	AC Energy (kWh)	Energy Value ($)
1	3.80	473	59.12
2	4.56	515	64.38
3	4.89	594	74.25
4	5.19	577	72.12
5	5.40	594	74.25
6	5.42	561	70.12
7	5.59	590	73.75
8	5.47	582	72.75
9	4.93	520	65.00
10	4.01	458	57.25
11	3.13	360	45.00
12	2.87	354	44.25
Year	4.61	6178	772.25

Output Hourly Performance Data * Output Results as Text

About the Hourly Performance Data Saving Text from a Browser

Run PVWATTS v.1 for another US location or an International location
Run PVWATTS v.2 (US only)

Please send questions and comments regarding PVWATTS to Webmaster

Disclaimer and copyright notice

RETScreen® Energy Model - Solar Water Heating Project

Training & Support

Site Conditions		Estimate	Notes/Range
Project name		Process Hot Water	See Online Manual
Project location		New Hampshire	
Nearest location for weather data		Concord, NH	➡ Complete SR&HL sheet
Annual solar radiation (tilted surface)	MWh/m²	1.65	
Annual average temperature	°C	7.7	-20.0 to 30.0
Annual average wind speed	m/s	3.0	
Desired load temperature	°C	60	
Hot water use	L/d	2,000	
Number of months analysed	month	12.00	
Energy demand for months analysed	MWh	44.55	

System Characteristics		Estimate	Notes/Range
Application type		Service hot water (with storage)	
Base Case Water Heating System			
Heating fuel type	-	Natural gas - mmBtu	
Water heating system seasonal efficiency	%	80%	50% to 190%
Solar Collector			
Collector type	-	Glazed	See Technical Note 1
Solar water heating collector manufacturer		SunEarth	See Product Database
Solar water heating collector model		Empire EC-32	
Gross area of one collector	m²	3.05	1.00 to 5.00
Aperture area of one collector	m²	2.75	1.00 to 5.00
Fr (tau alpha) coefficient	-	0.71	0.50 to 0.90
Fr UL coefficient	(W/m²)/°C	4.13	1.50 to 8.00
Temperature coefficient for Fr UL	(W/(m·°C)²)	0.00	0.000 to 0.010
Suggested number of collectors		12	
Number of collectors		12	
Total gross collector area	m²	36.6	
Storage			
Ratio of storage capacity to coll. area	L/m²	62.0	37.5 to 100.0
Storage capacity	L	2,046	
Balance of System			
Heat exchanger/antifreeze protection	yes/no	Yes	
Heat exchanger effectiveness	%	85%	50% to 85%
Suggested pipe diameter	mm	19	8 to 25 or PVC 35 to 50
Pipe diameter	mm	38	8 to 25 or PVC 35 to 50
Pumping power per collector area	W/m²	0	3 to 22, or 0
Piping and solar tank losses	%	1%	1% to 10%
Losses due to snow and/or dirt	%	3%	2% to 10%
Horz. dist. from mech. room to collector	m	5	5 to 20
# of floors from mech. room to collector	-	2	0 to 20

Annual Energy Production (12.00 months analysed)		Estimate	Notes/Range
SWH system capacity	kW_{th}	23	
	million Btu/h	0.079	
Pumping energy (electricity)	MWh	**0.00**	
Specific yield	kWh/m²	656	
System efficiency	%	40%	
Solar fraction	%	54%	
Renewable energy delivered	MWh	**24.02**	
	kWh	24,021	
			Complete Cost Analysis sheet

RETScreen® Solar Resource and Heating Load Calculation - Solar Water Heating Project

Site Latitude and Collector Orientation		Estimate	Notes/Range
Nearest location for weather data		Concord, NH	See Weather Database
Latitude of project location	°N	43.2	-90.0 to 90.0
Slope of solar collector	°	43.2	0.0 to 90.0
Azimuth of solar collector	°	0.0	0.0 to 180.0

Monthly Inputs

(Note: 1. Cells in grey are not used for energy calculations; 2. Revisit this table to check that all required inputs are filled if you change system type or solar collector type or pool type, or method for calculating cold water temperature).

Month	Fraction of month used (0 - 1)	Monthly average daily radiation on horizontal surface (kWh/m²/d)	Monthly average temperature (°C)	Monthly average relative humidity (%)	Monthly average wind speed (m/s)	Monthly average daily radiation in plane of solar collector (kWh/m²/d)
January	1.00	1.91	-6.7	68.0	3.2	3.86
February	1.00	2.83	-5.1	66.0	3.4	4.73
March	1.00	3.88	0.6	64.6	3.6	4.86
April	1.00	4.73	7.0	62.2	3.5	4.84
May	1.00	5.61	13.5	65.3	3.1	5.06
June	1.00	6.08	18.4	70.6	2.9	5.20
July	1.00	6.06	21.1	72.0	2.6	5.30
August	1.00	5.30	19.8	74.6	2.4	5.14
September	1.00	4.18	15.1	76.3	2.5	4.80
October	1.00	2.91	8.9	73.1	2.6	4.22
November	1.00	1.80	3.2	73.3	3.0	3.11
December	1.00	1.52	-3.8	72.3	3.2	3.10

		Annual	Season of Use
Solar radiation (horizontal)	MWh/m²	1.43	1.43
Solar radiation (tilted surface)	MWh/m²	1.65	1.65
Average temperature	°C	7.7	7.7
Average wind speed	m/s	3.0	3.0

Water Heating Load Calculation		Estimate	Notes/Range
Application type	-	Service hot water	
System configuration	-	With storage	
Building or load type	-	Industrial	
Number of units	-	-	
Rate of occupancy	%	-	50% to 100%
Estimated hot water use (at ~60 °C)	L/d	N/A	
Hot water use	L/d	2,000	
Desired water temperature	°C	60	
Days per week system is used	d	7	1 to 7
Cold water temperature	-	Auto	
Minimum	°C	2.6	1.0 to 10.0
Maximum	°C	12.4	5.0 to 15.0
Months SWH system in use	month	12.00	
Energy demand for months analysed	MWh	44.55	
	million Btu	151.98	

Return to Energy Model sheet

Pay backs

80 % Instaneous 14.5 years

86 % Condensing 15.6 "

90 % Storage tank (HE) 12.7 "

8/29/2010; Laundromat NH

US C&I commercial state rebates

Colorado 30% or $16K

Vermont 30% no cap

Oregon 35% no cap

Georgia 35% or $100,000 cap

Hawaii 35% or $250,000 cap

North Carolina 35% 05 $2.5 mil cap

Delaware 33.3 for pv wind and others except thermal hot water at 50% $250,000 cap

Louisiana 50 % first $25,000 or $12,500

This "calculator" can be used to compare residential heating fuel prices an
the yellow-colored cells as necessary. The information in the green cells is
information on this page. Detailed instructions are provided in the Instru
Contact local suppliers for most accurate prices. This calculator will n

Fuel Type	Fuel Unit	Fuel Price Per Unit (dollars)	Fuel Heat Content Per Unit (Btu)	Fuel Price Per Million Btu (dollars)
Fuel Oil (#2)	Gallon	$2.65	138,690	
Electricity	KiloWatt-hour	$0.111	3,412	
Natural Gas [1]	Therm [2]	$1.05	100,000	
Propane	Gallon	$2.11	91,333	
Wood [3]	Cord	$200.00	22,000,000	
Pellets	Ton	$250.00	16,500,000	
Corn (kernels)	Ton	$200.00	16,500,000	
Kerosene	Gallon	$3.20	135,000	
Coal (Anthracite)	Ton	$200.00	25,000,000	

NOTES:

1 Natural gas is typically sold to residential customers in units of "therms," but ma

2 One therm = 100,000 Btu, and is equivalent to about 97.18 cubic feet (or 0.972
To convert prices in $/Mcf (1,000 cubic feet) to $/therm, divide the $/Mcf

3 The heat content value for a cord of wood varies by tree species and is greatly

4 For definitions of Efficiency Ratings and referrals to where they can be obtained
Some types of heaters do not have efficiency ratings; the ratings in the yellow c

5 The default values are the minimum efficiency standards set by the U.S. Depart